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09/772,457	01/30/2001	Kenji Nakamura	021-01	7152

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EXAMINER

LEADER, WILLIAM T

ART UNIT

PAPER NUMBER

1742

DATE MAILED: 08/13/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/772,457

Applicant(s)

NAKAMURA ET AL.

Examiner

William T. Leader

Art Unit

1742

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 02 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) 7,8 and 10 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 9 is/are rejected.
- 7) ☒ Claim(s) 11 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 January 2001 is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3,4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### **DETAILED ACTION**

1. Applicant's election with traverse of the species of paragraph "a", readable on claims 1-6, 9 and 11 in Paper No. 6, filed on June 2, 2003, is acknowledged. The traversal is on the ground(s) that the search of directed to one of the species would overlap with the search for the other species. This is not found persuasive because the subject matter of the different species is classified in diverse subclasses. Claims 7, 8 and 10 are withdrawn from consideration.

The requirement is still deemed proper and is therefore made FINAL.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. As written, claim 2 is prima facie indefinite because it is dependent on itself. For the purpose of comparison with the prior art, claim 2 will be interpreted as if it were dependent on claim 1.

### ***Claim Rejections - 35 USC § 102***

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent

granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1 and 6 are rejected under 35 U.S.C. 102(e) as being anticipated by Basol (6,534,116).
5. The Basol patent is directed to a plating method that creates a differential between the concentration of a plating additive disposed on a top surface of the workpiece and in a cavity. The process of Basol may be used with any substrate such as a semiconductor or flat panel (column 7, lines 44-46). Basol discloses that photo-resist etching may be used to form features such as vias in the surface of the workpiece (column 1, lines 22-32). Figure 1 shows the presence of vias 4a in insulation layer 2 covering the substrate 3. This corresponds to the via of applicant. An initial seed layer 6, which may be made of copper, is deposited on the top surface of the insulation and on the bottom and walls of the vias. The seed layer may be formed by a process such as electroless deposition or sputtering (column 2, lines 55-59; figure 2a). This corresponds to the first step of applicant's process as recited in instant claim 1. The substrate is then exposed to a copper plating bath which includes additive A which enhances deposition when it is absorbed on the surface of the workpiece (column 9, lines 12-16). The corresponds to the second step of applicant's process in which the substrate is immersed in an aqueous solution containing a plating promoter to deposit the promoter on the surface of the initial

copper film. The surface of the substrate of Basol is then physically contacted with a mask which clears away additive A from the field regions (top surface). But the vias still contain the additive since they are not in direct physical contact with the mask (column 9, lines 22-28). This corresponds to the third step of applicant process in which the plating promoter is removed from the surface of the copper film while leaving the promoter on the side and bottom walls of the vias. Finally, Basol electroplates the substrate with copper. Because of the differential in the concentration of promoter A, the bottom and side surfaces of the features with the adsorbed additive A would immediately start plating at a higher rate than the field regions (column 9, lines 28-31). It is known that plating may be continued until the vias holes and filled and a layer of copper is formed over the surface of the substrate (figure 2b). This corresponds to the last step in applicant's process. The sweeping of the surface with a mask which is in physical contact with the surface to remove additive A may be considered to be a polishing step as recited in instant claim 6.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 2-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Basol in view of Tsai et al (6,224,737).

Basol is taken as above. Basol further discloses that multiple additives may be used. In addition to the promoter additive A which enhances deposition of copper, the plating solution may include an inhibitor B (column 9, lines 51-55).

Claim 2 differs from the process of Basol by reciting promoters with a specified formula. The Tsai et al patent is directed to a method for improving the gap filling capability of copper electroplating. Tsai et al disclose depositing a copper seed layer 13 on the bottom and side walls of opening 14 as well as on the surface (column 4, lines 63-67; figure 6). Tsai teaches that it is known to deposit copper from an electroplating which includes suppressing additives and brightening

additives which locally accelerate deposition rates (column 1, lines 33-48). The brighteners may be mercapto compounds having a general formula shown at column 1, line 53. This formula is the same as that of applicant's claim 2. The formula includes 3 carbon atoms and represents 3-mercapto-1-propanesulfonate as recited in instant claim 3. Tsai disclose that the electroplating solution may contain polyethylene glycol. This suggests the limitations of instant claims 4 and 5.

The Gundel et al patent (2,830,014) is directed to an electroplating process and discloses compounds which serve of brightening additives. While Tsai et al disclose that 3-mercapto-1-propanesulfonate is a known brightening additive, they do not specifically teach the use of the sodium salt. Gundel disclose that mercaptopropane-1-sodium sulfonate is a recognized brightener (column 2, line 16), thus suggesting the sodium salt form of the compound.

The prior art of record is indicative of the level of skill of one of ordinary skill in the art. It would have been obvious at the time the invention was made to have utilized sodium 3-mercapto-1-propanesulfonate as additive A of Basol and polyethylene glycol as additive B because these additives are shown by Tsai et al and Gundel et al to be recognized copper-plating additives which perform the functions set forth in Basol.

9. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Basol in view of Japanese unexamined patent publication 2000-219994.

10. Applicant has provided a partial translation of Japanese publication '994. This publication is directed to a process for electroplating copper into via holes for minute wiring lines on a multi-layer printed circuit board or wafer. Prior to electroplating, an additive, particularly a brightener component, is adsorbed onto the material to be plated. The publication teaches that after the additive is adsorbed onto the workpiece, the electroplating may be plated using a solution which does not contain a brightener. This corresponds to the limitation of instant claim 9. It would have been obvious at the time the invention was made to have performed subsequent plating in the process of Basol from a solution without a brightener as suggested by Japanese publication '994 because the brightener would have already been applied to the substrate. Based on the translation provided, it is noted that the process of instant claim 1 differs from that of the Japanese publication by reciting a step of removing the plating promoter from the surface of the copper film prior to electroplating.

11. Claim 11 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art of record does suggest




forming a strike plating of copper on the surface of the initial copper film formed in claim 1 prior to the immersion of the substrate in the plating promoter-containing solution.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William T. Leader whose telephone number is 703-308-2530. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King, can be reached on 703-308-1146. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

  
William Leader  
August 7, 2003

  
ROY KING  
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